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R. R. DAVIS — A. D. PRATT

OHIO AGRICULTURAL EXPERIMENT STATION

Wooster, Ohio

CITED REFERENCES

1. Brundage, A. L. and W. E. Petersen. A comparison between daily rotational grazing and continuous grazing. Jour. Dairy Sci. 35:623-630. 1952.
2. Davis, R. R. and D. S. Bell. Unpublished data.
3. Fuelleman, R. F., W. L. Burlison and W. G. Kommlade. Methods of management of a bromegrass-alfalfa mixture. J. Animal Sci. 7:100-109. 1948.
4. Gaines, W. L. The energy basis of measuring milk yield in dairy cows. Univ. of Illinois Expt. Sta. Bul. 308, 1927.
5. Hancock, John and C. P. McMeekan. Studies of grazing behavior in relation to grassland management. III. Rotational compared with continuous grazing. Jour. of Agr. Sci. 45:96-103. 1954.
6. Harrison, C. M., G. Williams and W. N. Fischer. Continuous and rotation grazing of a legume-grass mixture with dairy cows. Jour. Amer. Soc. Agron. 40:357-363. 1948.
7. Harrison, C. M., C. L. Cole, and H. C. Rather. Continuous and rotation grazing of alfalfa-bromegrass pastured with ewes and lambs. Soil Sci. Soc. Amer. Proc. 6:303-308. 1941.
8. Hodgson, R. E., M. S. Grunder, J. C. Knott, and E. V. Ellington. A comparison of rotational and continuous grazing of pastures in western Washington. Wash. Agr. Expt. Sta. Bul. 294. 1934.
9. Holmes, W., R. Waite, D. L. Fergusson and Jean I. Campbell. Studies in grazing management I. A comparison of the production obtained from close-folding and rotational grazing of dairy cows. Jour. of Agr. Sci. 40:380. 1950.
10. Holmes, W., R. Waite, D. L. Fergusson and D. S. MacLusky. Studies in grazing management IV. A comparison of close-folding and rotational grazing of dairy cows on intensively fertilized pasture. Jour. of Agr. Sci. 42:304-313. 1952.
11. Ittner, N. R., G. P. Lofgreen and J. H. Meyer. A study of pasturing and soiling alfalfa with beef steers. J. Animal Sci. 13:37. 1954.
12. Knott, J. C., R. E. Hodgson and E. V. Ellington. Methods of measuring pasture yields with dairy cattle. Wash. Agr. Expt. Sta. Bul. 295. 1934.
13. Moore, R. M., Nancy Barrie, and E. H. Kipps. Grazing management: Continuous and rotational grazing by Merino sheep. 1. A study of the production of a sown pasture in the Australian capital territory under three systems of grazing management Council for Scientific and Industrial Research. Bul. No. 201. 1946.
14. Morrison, F. B. Feeds and feeding, 20th Ed. Morrison Publ. Co. 1946.
15. Proctor, J., A. E. M. Hood, W. D. Fergusson, and A. H. Lewis. The close-folding of dairy cows. Jour. Brit. Grasslan. Soc. 5:243-250. 1950.

ROTATIONAL VS. CONTINUOUS GRAZING WITH DAIRY COWS

R. R. DAVIS and A. D. PRATT

The practice of moving grazing animals from one area to another in rotation has been studied for many years. There is still apparently much disagreement among investigators, particularly in the United States, about the merits of rotational grazing.

Hodgson *et al.* (8) compared a 6-paddock rotation system with a continuous grazing system using lactating Holstein cows. The authors obtained an increase of about 9% in TDN and standard cow days per acre from rotational grazing over that obtained by continuous grazing. They concluded that the additional nutrients obtained when using the rotation system were probably not worth the cost.

Harrison *et al.* (6) (7) compared rotational grazing with continuous grazing using dairy cows and ewes and lambs and concluded that there was no advantage from rotational grazing. Fuelleman *et al.* (3) reported better utilization of forage and highest gain of lambs per acre from heavy alternate grazing when comparing two stocking intensities with continuous and alternate grazing. Alfalfa lived longer under alternate grazing. Moore *et al.* (13) reported no advantage to rotational grazing other than lengthening the life of alfalfa over continuous grazing.

Holmes *et al.* (9) (10), Proctor *et al.* (15), Brundage and Petersen (1), and Ittner, *et al.* (11) reported much advantage from intense rotational grazing (close folding or daily rotation) when results are expressed in terms of animal product per acre. No difference in total yield per animal was reported in any of the above experiments.

Hancock and McMeekan (5) found that dairy cows try to compensate for deficiencies in quantity and quality of forage in a pasture by spending more time grazing. They report more milk production per cow for rotationally grazed pasture than from continuously grazed pasture when measured over a long season, during a part of which the continuously grazed cows did not have an adequate quantity of feed.

ACKNOWLEDGMENT

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EXPERIMENTAL PROCEDURE

Continuous grazing was compared with a 6-paddock rotational grazing system at the Ohio Agricultural Experiment Station, Wooster, in 1951, 1952, and 1953. Lactating registered Jersey cows grazed a mixture consisting of Ranger alfalfa, Ladino clover, and Lincoln brome-grass. Alfalfa was dominant in the mixture at the beginning of the experiment.

The soil types of the experimental area were Canfield silt loam, Wooster silt loam, and a small area of Ravenna silt loam. The area had been maintained at pH 6.5–7.0 for about 12 years previous to the experiment. A 5-year rotation of corn, oats, and 3 years of meadow along with modest applications of mixed fertilizer and liberal use of manure made the experimental area fertile. The experimental seedings received 500 lbs. per acre of 0-20-10 at planting time and 300 lbs. per acre per year of 0-20-20 for maintenance.

The cows were bred to calve in February, March and early April. They were pastured 10-15 days on bluegrass before being turned on experimental pastures.

The cows being grazed rotationally remained on a paddock 4 to 10 days. An attempt was made to utilize the forage as completely as possible without an obvious adverse affect on the milk production of the cows. Paddocks not needed for grazing on the rotationally grazed pastures were harvested for grass silage or hay and yields were taken. There was no harvest other than grazing on the continuously grazed pasture—no clipping was done. The rotationally grazed paddocks were usually mowed after grazing. If there were no weeds or stemmy residue to justify mowing, the mowing was omitted.

In 1951, six adjacent 3-acre fields were divided with a cross-fence to make six 1½-acre paddocks for rotational grazing on one side and a 9-acre pasture for continuous grazing on the other side of the cross-fence. Ten lactating Jersey cows were assigned to the rotational grazing treatment and 10 were assigned to the continuous grazing treatment. The experimental grazing season was from May 9 to September 7, a period of 121 days. All cows were individually fed a grain mixture containing 15.7% protein while in the barn for milking. This ration was designated ration 35 and was composed of the following: 450 lbs. ground yellow corn, 300 lbs. ground oats, 100 lbs. wheat bran, 150 lbs. soybean oil meal (41%), 10 lbs. bonemeal and 10 lbs. salt. A limit of one pound of grain per 5 pounds of 4% milk was set as a maximum for grain feeding, but all cows voluntarily ate less grain than they would have been allowed. As much mixed hay as they would eat was also fed individually to all cows while in the barn. Individual daily consumption records were kept on both grain and hay. The same pattern for feeding grain and hay was continued in 1952 and 1953.

In 1952, the pasture fields were re-arranged to allow 3 replications of the rotational and continuous grazing treatments. Four of the fields that were cross-fenced in 1951 were used along with two fields that were seeded in 1951. Adjacent pastures were paired and the two grazing treatments were assigned at random to the pairs. Three 3-acre pastures were each divided into six half-acre paddocks for rotational grazing and three others left intact for continuous grazing. Experimental grazing was started May 5 and terminated September 7, a period of 125 days.

Four cows were assigned to each 3-acre pasture. The cows were sorted on the basis of current milk production, previous milk production, date of calving, weight, and age. They remained on their respective pastures the entire grazing season. In addition, two cows on each pasture received a 15.7% protein (No. 35) grain ration and two cows received a 10.1% protein grain ration (No. 59). Ration No. 59 was composed of the following: 500 lbs. corn and cob meal, 500 lbs. ground oats and 10 lbs. salt.

The grazing experiment continued on the same pastures in 1953. The grazing season began May 7 and ended September 7, a period of 123 days. Five Jersey cows were grazed on each 3-acre pasture rather than 4 cows as in 1952. The cows received three grain treatments. They were (1) no grain, (2) 10.1% protein ration (No. 59 as fed in 1952), and (3) 15.9% protein ration (No. 35 without bonemeal).

The cows were sorted into 3 groups of 6 and 3 groups of 4 based on current milk production, weight, past milk production, stage of lactation, and age. A group of six was assigned at random to the paired pastures representing one replication of the grazing treatments, each of the three on one pasture assigned to a grain ration. The groups of 4 were assigned in a like manner, with one cow on a pasture getting no grain and the other the 15.9% protein ration. The result of the sorting procedure was 5 cows per pasture, 2 receiving no grain, one receiving the 10.1% protein ration, and 2 receiving the 15.9% protein ration. The experimental design was a split plot with grazing treatments the main plots.

RESULTS

ANIMAL DATA

The quantity of 4% fat-corrected milk produced per cow during the experimental grazing season was calculated by the method of Gaines (4). Table 1 shows that grazing method had very little effect on milk production per cow. There were some small differences each year in favor of rotational grazing, but this difference was well within the scope of experimental error.

TABLE 1.—Pounds of 4% Milk per Cow per Day During the Grazing Season

	1951	1952		1953			Avg. (Yrs.)
		Low protein ration	High protein ration	No grain	Low protein	High protein	
Rotational Grazing. .	34.6	35.5	29.8	26.4	28.4	31.3	32.0
Continuous Grazing.	34.0	30.6	34.4	23.6	29.2	30.8	31.4
Avg. Rations	——	33.0	32.1	25.0	28.8	31.1	——
Avg. Years	34.3	32.6			28.2		31.7
LSD Ration Means at 10% Level . . .	——	N. S.			3.9		
C. V. Grazing	——	6.5%			19.1%		
C. V. Rations	——	5.9%			18.3%		
Coef. Animal Variability	——	21.4%			17.9%		

There was no difference in total milk production between cows getting the two grain rations fed in 1952. There was no significant difference in milk production of cows getting high and low protein grain in 1953 but a small consistent difference in favor of the high protein ration. If there was a real difference in production of the two groups getting grain, it can be accounted for by a higher rate of consumption of the high protein grain (See Table 4). The cows receiving grain in 1953 gave more milk than those receiving no grain. An apparent interaction of grain ration and grazing method in 1952 is discounted since there was no indication of an interaction in 1953.

TABLE 2.—Pounds of TDN per Acre From Pasture Calculated From Animal Performance

	1951	1952		1953			Avg. (Yrs.)
		Low protein ration	High protein ration	No grain	Low protein	High protein	
Rotational Grazing* .	1870	2110	1910	2870	2820	2370	2190
Continuous Grazing .	1840	1820	1990	2600	2300	2240	2040
Avg. Ration	——	1960	1950	2740	2560	2300	——
Avg. Years	1860	1960			2530		2110
LSD Ration Means at 5% Level	——	N. S.			410		
C. V. Grazing . . .	——	10.2%			18.9%		
C. V. Rations	——	14.7%			12.2%		
Coef. Animal Variability	——	15.3%			11.4%		

*Does not include TDN from harvested forage.

The quantity of total digestible nutrients (TDN) obtained from pasture by the grazing animals was calculated by the method of Knott *et al.* (12). Table 2 shows that grazing method had very little effect on TDN from pastures if forage harvested from rotationally grazed lots is disregarded. As for milk production, there was a small but statistically insignificant advantage each year in favor of rotational grazing. The data for 1953 indicate that the cows receiving no grain largely made up this deficiency by consuming more pasture. Since actual pasture consumption studies were not made, the point of increased pasture consumption with no grain is at best a weak one. When measuring TDN obtained by grazing, there was no interaction of grazing method and grain ration.

The excess forage not needed for grazing on the rotationally grazed pastures was harvested and yields were taken. This harvested forage was converted to TDN using Morrison's (14) tables and added to the TDN calculated from the grazed areas based on animal performance. Table 3 shows a consistent advantage of rotational grazing over continuous grazing. This difference is due primarily to harvested forage from the rotationally grazed pastures during the flush season for forage growth. The differences in years are due to both seasonal differences and age of pasture stand. There was no interaction of years and grazing method.

TABLE 3.—Pounds TDN per Acre as Calculated From Animal Performance Plus Harvested Forage

	1951	1952	1953	Avg.
Rotational Grazing	3080	2540	3050	2890
Continuous Grazing	1840	1900	2380	2040
Avg.	2460	2220	2720	2470
LSD Grazing Means at 10% Level	—	520	570	—
C. V. Grazing	—	9.8	8.8	—
LSD Years (1952-1953) at 1% Level	450			
C. V. Years (1952-1953)	6.9%			
C. V. Grazing (1952-1953)	11.5%			

During the grazing experiment, the cows were fed grain *ad lib.* while they were in the barn being milked. They were in the stanchions about 2 hours at each milking. Table 4 shows the grain consumption of the cows for the experimental grazing season. There was no difference in grain consumption due to grazing method. The high protein ration was consumed in greater quantity, very likely due to better palatability of the ration because of its content of soybean oil meal and freedom from cobs. The relatively low experimental error in 1952 and the high error in 1953 cannot be explained.

TABLE 4.—Pounds of Grain Consumed per Cow per Day During the Experimental Grazing Period

	1951	1952		1953		Avg. (Yrs.)
		Low protein ration	High protein ration	Low protein	High protein	
Rotational Grazing	4.6	5.5	5.8	4.3	6.2	5.2
Continuous Grazing	4.6	5.5	5.8	4.8	5.9	5.2
Avg. Rations	—	5.5	5.8	4.5	6.0	—
Avg. Years	4.6	5.6		5.3		5.2
LSD Ration Means at 1% Level	—	0.3		N. S.		
C. V. Grazing	—	4.6%		20.2%		
C. V. Rations	—	2.9%		32.0%		
Coef. Animal Variability	—	7.9%		27.9%		

TABLE 5.—Pounds of Hay Consumed per Cow per Day During the Experimental Grazing Period

	1951	1952		1953			Avg. (Yrs.)
		Low protein ration	High protein ration	No grain	Low protein	High protein	
Rotational Grazing .	3.0	4.5	4.4	4.2	3.8	4.2	3.8
Continuous Grazing.	2.9	4.4	4.5	3.8	4.3	5.0	3.9
Avg. Rations . . .	——	4.4	4.4	4.0	4.0	4.6	——
Avg. Years	2.9	4.4			4.3		3.9
C. V. Grazing	——	8.6%			7.4%		
C. V. Rations	——	16.0%			32.0%		
Coef. Animal Variability	——	10.9%			17.6%		

In addition to grain, the cows were individually fed mixed hay, as much as they would eat, while in the barn being milked. Table 5 shows grazing method did not influence the hay consumption of the cows. Neither did grain ration influence hay consumption. The cows getting no grain in 1953 ate no more hay than those getting grain.

The total TDN in barn feed consumed by the cows while grazing experimental pastures was calculated using Morrison's (14) tables. Table 6 shows that grazing method had no effect on the consumption of

TABLE 6.—Pounds of TDN in Barn Feed Consumed per Cow per Day During the Experimental Grazing Period

	1951	1952		1953			Avg. (Yrs.)
		Low protein ration	High protein ration	No grain	Low protein	High protein	
Rotational Grazing .	5.0	6.4	6.6	2.2	5.2	6.8	5.4
Continuous Grazing	4.9	6.3	6.6	1.9	5.8	7.0	5.4
Avg. Rations	——	6.3	6.6	2.0	5.5	6.9	——
Avg. Years	5.0	6.5			4.7		5.4
LSD Ration Means at 5% Level	——	N. S.			1.6		
C. V. Grazing	——	7.2%			14.3%		
C. V. Rations	——	5.8%			31.5%		
Coef. Animal Variability	——	7.0%			22.6%		

supplemental feed. The cows receiving no grain in 1953 consumed much less TDN in the barn than the groups receiving grain.

While on the grazing experiment, the cows were weighed at 4-week intervals in addition to a starting and concluding weight. They were weighed after the morning milking in each case. An average of three-day weights was taken as the best available estimate of true weight. Table 7 shows that weight changes among the cows were highly variable. The high coefficients of variability are explained by the fact that the mean gain was so near zero. It appears, however, that cows grazing rotationally gained more than those grazing continuously. There is also an apparent difference in the gain of the groups getting the two grain rations in 1952. The groups getting the high protein grain ration gained more than the groups getting the low protein ration, perhaps due to higher rate of consumption of the high protein ration. There was also an interaction of grazing method and grain ration in 1952, but this is discounted since there was no evidence of interaction in 1953. The cows getting no grain in 1953 gained as much as those getting grain.

TABLE 7.—Change in Body Weight (pounds) per Cow During the Experimental Grazing Period

	1951	1952 Low protein ration	1952 High protein ration	1953 No grain	1953 Low protein	1953 High protein	Avg. (Yrs.)
Rotational Grazing .	20	20	63	51	69	51	40
Continuous Grazing.	30	27	12	24	—1	24	22
Avg. Rations	—	23	38	38	34	38	—
Avg. Years	25	31			37		31
LSD Grazing Means at 10% Level	—	17			N. S.		
LSD Ration Means at 10% Level . .	—	14			N. S.		
C. V. Grazing	—	45.8%			96.2%		
C. V. Rations	—	50.2%			108.5%		
Coef. Animal Variability	—	127.8%			100.0%		

CAGE DATA

Cages were used to protect a pasture area of 16 square feet (4 ft. × 4 ft.). In 1952 and 1953, five cages in each rotationally grazed paddock were harvested and moved to a new paddock just before the cows were moved. Harvests were made as often as it was necessary to move the cows. Each time a caged area was harvested, a grazed area of equal size in the proximity of the cage was also harvested. The grazed area was marked when the cage was set. Either the caged area or the marked area to be left uncaged was selected at random and an area in the proximity selected to match it.

Twelve cages were used in each continuously grazed pasture in 1952 and in 1953. The caged areas were harvested at intervals of about two weeks. An uncaged area for each cage was marked and harvested as described above for cages in rotationally grazed pastures. All harvests were made with a small power scythe with sickle-bar cutting action. The plants were cut as close to the ground as possible. The cages were set in another location and a new uncaged area marked after harvesting.

When caged or uncaged areas were harvested, the green weight was taken immediately and a sample taken for moisture determination. In 1953, a composite of caged samples and a composite of uncaged samples was taken each time harvests were made in a pasture and the composite samples were analyzed for total nitrogen by the Kjeldahl method.

Figure 1 shows the percent total nitrogen in pasture samples from rotationally and continuously grazed pastures. The nitrogen content of the caged samples from rotationally grazed pastures remained above 2.5 percent except for the last two weeks of the first grazing cycle. With the start of the second grazing cycle, the nitrogen content of the caged samples remained above 2.6 percent with minor exceptions. The uncaged samples which had been grazed over were lower in nitrogen content but generally parallel to those of the caged samples. The forage that the grazing animals were actually eating was probably higher in total nitrogen than the caged samples since the samples included the base of stems which the cows did not eat. It is a safe assumption that the pasture diet of the cows was no lower in nitrogen than the average of caged and uncaged samples which was 2.6 percent for the season. Using the conversion factor 6.25, the average crude protein content of the forage on rotationally grazed pastures was at least 16 percent. Unless the protein was of low digestibility, it should have been adequate in quantity for high producing cows.

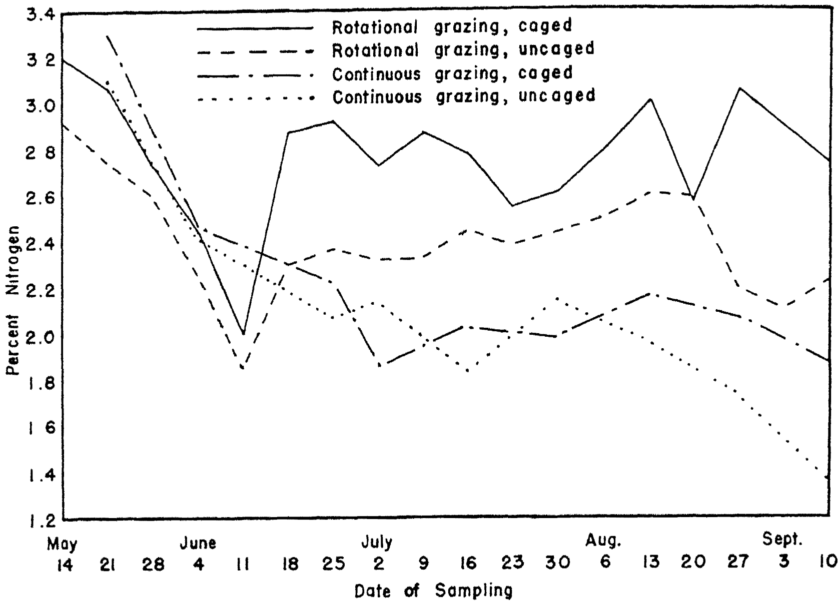

Fig. 1.—Average percent total nitrogen in dry matter of forage samples taken from caged and uncaged areas, 1953. Sampling date is an approximation.

During the first five weeks of the grazing season, the nitrogen content of samples from the continuously grazed pastures was at least as high as that in the samples from rotationally grazed pastures. The continuously grazed pastures did not exhibit the sharp drop in nitrogen content that the rotationally grazed pastures showed the latter part of the first grazing cycle. After a steady decline for 7 or 8 weeks, the nitrogen content of continuously grazed pastures leveled off at about 2 percent except for a drop the last two weeks of the season. The consistent difference in the caged and uncaged samples of rotationally grazed pastures was not evident in continuously grazed pastures. This fact is not surprising since the continuously grazed pastures were not so completely grazed during the interval between cage harvests. The seasonal average nitrogen content of caged and uncaged samples from continuously grazed pastures was 2.1 percent. The nitrogen content of the forage the cows were eating was very likely higher than that in the samples. The samples contained the stemmy residue from the early growth of forage as well as any new growth. There was no evidence that cows on continuously grazed pastures did not get enough protein in 1953.

The percentage of dry matter in caged and uncaged samples of both rotationally and continuously grazed pastures is shown in Figure 2. The data shown are averages of samples taken in 1952 and 1953. The dry matter content of caged samples from the rotationally grazed pastures increased steadily the first five weeks of the grazing season which was the first grazing cycle. It remained essentially in the range 25 to 30 percent the remainder of the season. Since they contained a higher percentage of stems, the dry matter content of uncaged samples was consistently higher than that of caged samples. Probably the forage consumed by the cows was somewhat lower in dry matter than the samples.

The samples from the continuously grazed pastures show a steady increase in dry matter the first part of the season, a level period in mid-season, and an increase in dry matter the latter part of the season. Except for the first five weeks, the samples from continuously grazed pastures were higher in dry matter than those from rotationally grazed pastures. Again, the cows were probably eating forage lower in dry matter than the samples.

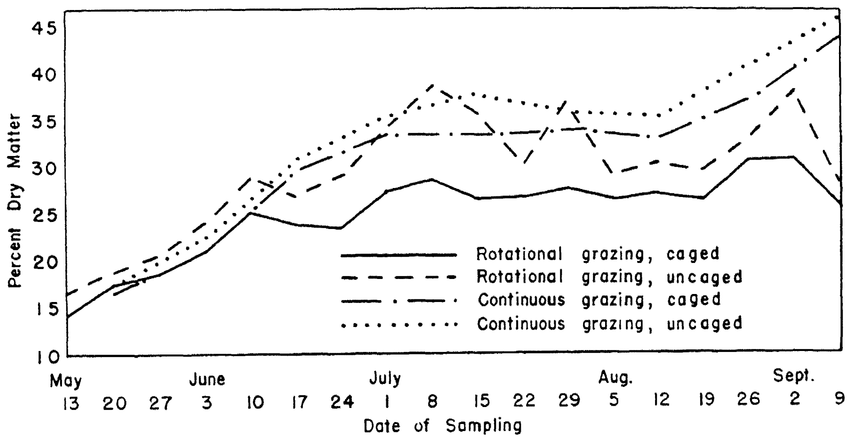

Fig. 2.—The percent dry matter in forage samples taken from caged and uncaged areas, average 1952 and 1953. Sampling date is an approximation.

An estimate of the percentage of the available dry matter consumed by the cows as measured by cage harvests is shown in Figure 3. The percentage consumed is the difference in dry matter yield of caged and uncaged areas expressed as a percent of the yield of the caged area. The percentage consumed is underestimated if based on a hay yield since the samples were cut closer than if for hay and the stemmy portion near the ground is high in dry matter. The poorest utilization of the available forage was when it was most rank. The forage was progressively better utilized for the remainder of the season after the first grazing cycle of the rotationally grazed pastures.

The curve for the continuously grazed pastures represents the percent of available forage consumed between cage harvests, an interval of approximately two weeks. As with the rotationally grazed pastures, the period of lowest percent consumed is when the forage is most rank. The reasons for the apparent decline in percent consumed late in the season are not known.

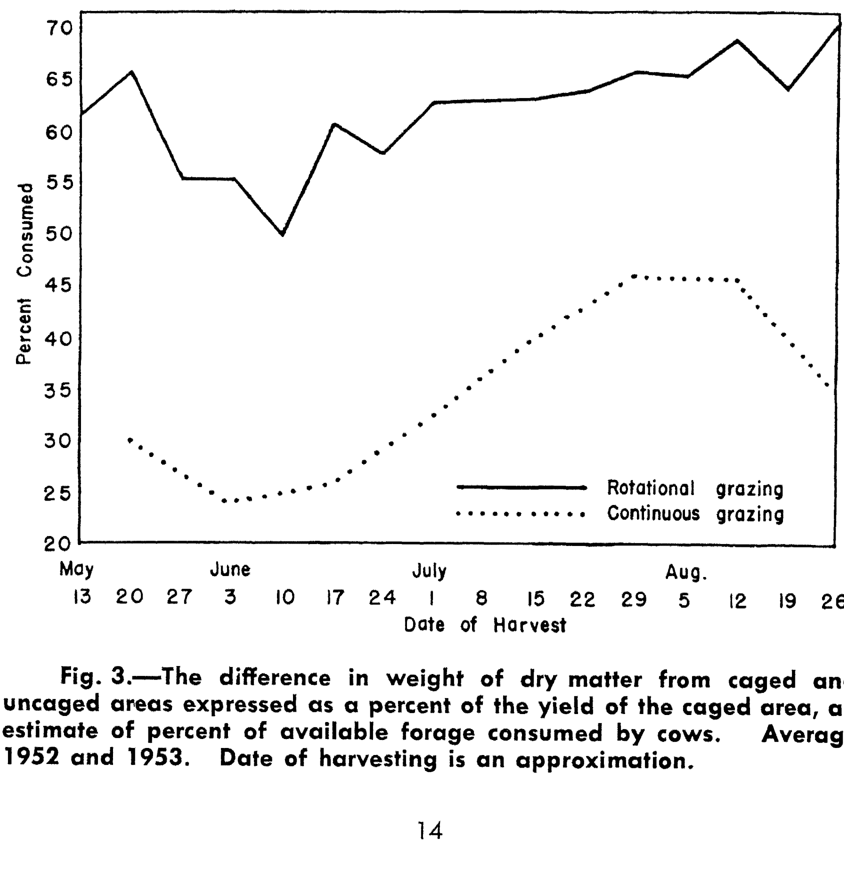

Fig. 3.—The difference in weight of dry matter from caged and uncaged areas expressed as a percent of the yield of the caged area, an estimate of percent of available forage consumed by cows. Average 1952 and 1953. Date of harvesting is an approximation.

DISCUSSION AND CONCLUSIONS

The results of the experiment reported here fall between those reported elsewhere showing no difference in rotational and continuous grazing and those showing extreme differences. Experiments with grazing management cannot be completely objective. The experimenter(s) must make decisions about stocking rate or grazing pressure based on judgment. It is not likely that two individuals would make exactly the same decision with a given set of conditions. The differences in judgment of individual experimenters are no doubt partly responsible for the wide range of results from comparisons of rotational and continuous grazing reported in the literature.

The results of a grazing management experiment can be greatly influenced by the method by which the pastures are stocked. Where a constant number of animals are used as with the experiment reported here, there is opportunity for much wasted forage during the season of flush growth on continuously grazed pastures. When a put-and-take system of stocking is used, the number of animals is adjusted to the amount of forage available and, in theory, there should be no more wastage on one grazing system than another if the pastures are properly stocked. Consequently, no difference in rotational and continuous grazing should be expected when using the put-and-take system until there is a change in botanical composition of the pastures sufficiently large to measure. Davis and Bell (2) have found no difference in gain per acre when grazing two mixtures rotationally and continuously with lambs for two seasons when using the put-and-take system.

Stand counts or separation of samples were not made to determine changes in botanical composition resulting from the two grazing treatments. However, it was obvious that the stand of alfalfa decreased and the stand of bromegrass increased with time on the continuously grazed pastures. An excellent stand of alfalfa was maintained over the three years on the rotationally grazed pastures. (See Figure 4). The amount of Ladino clover present varied with the availability of moisture. Two of the pastures grazed rotationally and two that were grazed continuously in 1952 and 1953 were kept for grass silage and pasture in 1954.

TABLE 8.—The Average Pounds of Dry Matter per Acre, 1954

	1st harvest May 27	2nd harvest July 9
Previously rotationally grazed	4420	2330
Previously continuously grazed	4670	1270

Table 8 shows the yield from these fields as estimated from harvested samples. There was sufficient leguminous nitrogen present to make a good first-harvest yield from a predominately bromegrass sod on the continuously grazed pastures. The second harvest, being largely an expression of alfalfa stand, shows the magnitude of alfalfa loss on the continuously grazed pastures. A third harvest was not taken, but the yields would probably have been proportional to those obtained in the second harvest.

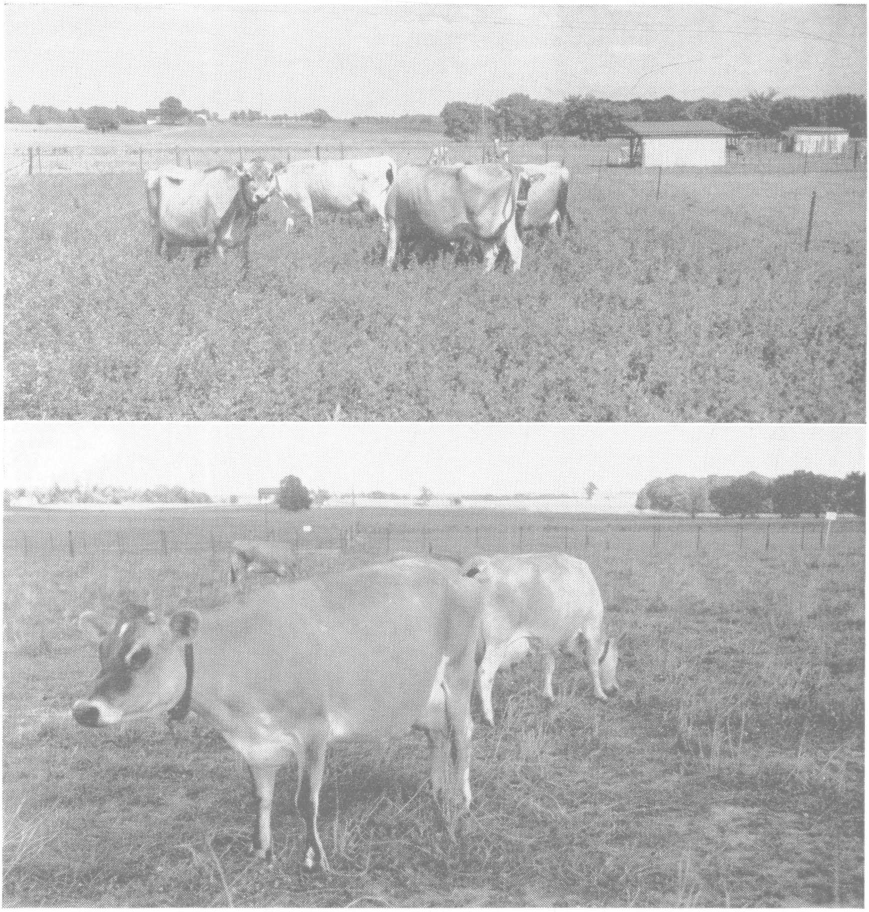

Fig. 4.—An excellent stand of alfalfa was maintained on rotationally grazed pastures (top) while being seriously reduced on continuously grazed pastures (bottom). Photos taken August 18, 1953.

If the experiment had been conducted on an area less well adapted to alfalfa, a more serious reduction of alfalfa stand would have resulted. The three growing seasons of the experiment (1951-53) were drier than normal, which was favorable for longevity of alfalfa stands under adverse management.

Other than encouraging the maintenance of the alfalfa stand, the only concrete difference in rotational and continuous grazing shown by the data reported here is conservation of forage not needed for grazing on the rotationally grazed pastures. Where a constant number of animals is used, as is the case with most dairy farms, there is always more forage on pastures in the spring than is needed for grazing providing there is sufficient area for adequate grazing during July and August. A continuous grazing system does not lend itself to conserving this excess forage.

The experiment reported here shows no difference in performance per animal whether grazed rotationally or continuously. This is in agreement with practically all grazing management studies, providing the animals under each treatment have an adequate quantity of forage. Since a cow will produce the same quantity of milk when pastured under a continuous grazing system as she will when pastured under a rotational grazing system, under what conditions should a rotational grazing system be used? In a farm enterprise where land area is limiting the size of the operation, rotational grazing can be practiced to good advantage since rotational grazing allows for more complete utilization of the forage grown. More animals per acre are possible with good forage utilization than with poor utilization at the same level of soil productivity. The more intensive the rotation system, and the higher the stocking rate per unit area being grazed, the more complete the utilization of available forage should be. The maintenance of legume stand is perhaps sufficient justification for rotational grazing where a pasture is to be grazed over a period of years. With the exception of maintaining better legume stands, rotational grazing is not likely to be worthwhile when labor, capital, barn space, or any factor other than land area is limiting the farm enterprise.

The practice of rotational grazing is not without disadvantages. An obvious disadvantage is the requirement for fencing to divide pastures into smaller units. Another one that cannot be overemphasized is the requirement for managerial ability. If cows being rotationally grazed are kept on a unit too long before moving to a fresh unit, production will be lowered. This is serious with lactating cows since they seldom recover to their previous level of production. On the other hand, if animals are not left on a unit sufficiently long to utilize the forage, the principal advantage of rotational grazing is lost. A third disadvantage of rotational grazing is illustrated by Figure 1 and Figure 5. The first growth of pasture forage gets too mature for best quality and palatability before the first paddock grazed has made sufficient recovery for the second grazing cycle.

Fig. 5.—The first growth of forage in the spring became too mature for high protein content and the most complete utilization by grazing before the pasture is ready for the second grazing cycle when grazing rotationally (top) while pastures grazed continuously (bottom) exhibit less abrupt changes in maturity. Photos made June 4, 1953.

There are advantages to rotational grazing other than more complete utilization of the forage and maintenance of legume stand which have already been discussed. The continuously grazed pastures were more seriously affected by a prolonged drought than the rotationally grazed pastures. However, production records show that the cows obtained more feed from continuously grazed pastures than appearance would indicate. The fact remains that the cows being grazed rotationally were grazing lush stands of alfalfa while drought had reduced forage on continuously grazed pastures to a low level. The rotational system of grazing allowed some units to make their growth while soil moisture was favorable. Except for a very short period in June, the cows grazing rotationally were obtaining a more uniform diet with a higher level of protein than the cows grazing continuously (see Figure 1).

The experiment shows that there is little justification for feeding a grain ration containing protein supplement to cows grazing legume-grass pastures. Where a high rate of grain feeding is desired, perhaps something to improve the palatability of the grain ration is justified. The addition of energy to the cows' diet in the form of grain did increase milk production. The quantity of grain that is profitable to feed to cows on good pasture would depend upon the grain-milk price relationship and the level of production of the cows.

SUMMARY

Three years results of a comparison of rotational and continuous grazing with lactating Jersey cows are reported. Milk production per animal and barn feed consumption were not significantly affected by grazing method. The rotational grazing system allowed for harvesting forage not needed for grazing during the flush season, resulting in more complete utilization of the forage produced.

Various grain rations fed to the cows during the experimental period showed that (1) cows receiving a grain mixture produced more milk than those getting no grain, and (2) cows grazing good legume-grass pasture do not need a protein supplement.

An analysis of samples from caged and uncaged areas in the pastures showed that the rotationally grazed pastures were higher in total nitrogen than the continuously grazed pastures except for the first few weeks of the season. However, the cows grazing continuously appeared to be getting sufficient protein to sustain an average milk production of about 30 pounds of 4% fat-corrected milk per day.

The following advantages and disadvantages of rotational grazing are discussed:

Advantages—

1. More complete utilization of forage—excess forage not needed for grazing harvested as grass silage or hay.
2. Legume stands, particularly alfalfa, are maintained longer.
3. Forage is of higher quality and more uniform most of the season.
4. Rotationally grazed pastures less seriously affected by drouth.

Disadvantages—

1. Higher cost.
2. Better managerial ability required.
3. The advanced stage of maturity reached by the first growth of forage in the spring becomes too mature for best quality and palatability before the second growth of the first paddock grazed is ready for grazing again.